himself by a good rest for the next day's journey. In fact, it would be better if an explorer never looked at the figures of an observation after he had recorded them, or read over the notes of his past work, confining himself to recording what he has actually seen day by day as accurately as circumstances permitted, and carefully distinguishing what he really saw from what he thought he had seen, or what he had heard.

It would be easy to adduce instances of the errors which have arisen from the neglect of such precautions. Perhaps one of the best known is that I have already alluded to, when James Bruce, a careful explorer, because he had made up his mind that the Blue Nile was the real Nile, passed the White Nile without taking the trouble to examine it, and recorded it as being a comparatively insignificant river. Then there was the case of Sir Samuel Baker, who, having reached the shores of the Albert Nyanza with great difficulty, depended too much on what he was told by the natives, and showed it on his map as extending many miles to the south of the equator. But great responsibility rests also upon those who have the task of compiling a map from the notes of an explorer, and the greatest care has to be taken to show only what is really known, and not what is uncertain. Geographers, whether in the field or in the drawing office, should always hold up before themselves a standard of accuracy higher than it is always easy to live up to.

Geography under its more ancient name of geometry is, of course, the mother of all sciences, although at the present time geometry has got a more narrow meaning, and is perhaps regarded by some as independent of geography, although really only a branch of it. The study of the earth upon which they lived was, to the ancient nations, the most important of all studies, and it is interesting to trace how astronomy, mathematics, geology, and ethnology are all so interspersed with geography that it is difficut to separate them. It is satisfactory to note how from the very first the British Association has always recognised the great importance of geography, since the first meeting of the Association at Oxford in 1832, when Sir Roderick Murchison, so well known to fame, acted as president of the Geographical and Geological Section. These two sciences remained united in the same section until the meeting at Edinburgh in 1850, when Sir R. Murchison was again the president. But, at the next meeting at Ipswich in 1851, they were separated, and while geology remained as the subject of Section C, geography, on account of its great importance, was made the subject of Section E, and the science of ethnology was united with it. Sir R. Murchison was the first president of the new Geographical Section, and was afterwards president no fewer than six times of Section E, showing the great importance attached by him to the study of the science of geography. May I express the hope that the presidents of the section will endeavour in future to follow, however humbly, in the footsteps of that leader of science.

SECTION G.

ENGINEERING.

OPENING ADDRESS BY PROF. ARCHIBALD BARR, D.SC., PRESIDENT OF THE SECTION.

ONE of the great engineers of the past, Leonardo da Vinci, prefaced a collection of observations on various themes, including the mechanical arts, with the remark:—"Seeing that I cannot choose any subject of great utility or pleasure, because my predecessors have already taken as their own all useful and necessary themes, I will do like one who, because of his poverty, is the last to arrive at the fair, and not being able otherwise to provide himself, chooses all the things that others have already looked over and not taken, but refused as being of little value. With these despised and rejected wares—the leavings of many buyers—I will load my modest pack, and therewith take my course." These words describe, with some approach to exactitude, the position in which I find myself, and may form a fitting introduction to an address that will be discursive rather than systematic, and perhaps more critical than constructive.

It may be less true to-day than it was four hundred years ago to say that all important matters concerning the existing state of the mechanical arts have been dealt with in spoken or written addresses. Each year there might be found sufficient subject-matter for a general survey of the ground that has been covered or a sketch of what lies before us. But each important advance is nowadays recorded as soon as it is made, and I do not feel that I have any special call to assume the *rôle* of the historian, nor can I claim any right to don the mantle of the prophet.

A president of this section who is not disposed to deal with the general aspects of the progress being made in the department of science allotted to us can usually find a large enough subject for his address within the limits of that part of our wide field with which his own work has been more particularly identified, and it might be expected that I would devote my address to a discussion of the conclusions at which I have arrived during thirty-six years of practice and experience in the teaching of mechanical science. But so much has been said of late on the training of engineers, and so many divergent and even irreconcilable opinions have been expressed regarding the lines such training should follow, that I feel sure I shall be relieving the apprehensions of some of my audience if I begin by stating that I do not propose to inflict upon you a discourse on that threadbare theme. There are limits to the endurance even of those who practise a profession well calculated to inculcate the virtues of patience and forbearance.

When we have as president of the section one who has broken new paths in the exploration of the territory assigned to us, or to whose labours the fruitfulness of some corner of the domain may be chiefly attributed, we would scarcely be disposed to tolerate the omission from his address of an account of his own special work, in investigation or in practice, and the developments to which it is leading. But while, no doubt, every worker is the chief authority on something or other, the plot he cultivates may be so restricted in area, and its products may bulk so little in the general harvest, as to form no suitable topic to engage the attention of his fellow-workers on such an occasion as this.

When an engineer leaves practice in the great, and takes to the devising and production of what are usually referred to specifically as "scientific instruments" (though all machines and mechanical appliances may properly be classed as such), his colleagues in the profession may be disposed to look upon the change as a degeneration of species. Naturally I am not disposed to accept such a verdict. Remembering the careers of those who did most in the founding of the various branches of present-day practice, I am quite prepared to accept as applicable another phase borrowed from the language of the biologist, and to let it be called a "reversion to a more primitive type." But instead of dealing with the narrow branch of applied science with which my own practice is chiefly connected, I prefer to utilise the short time at my disposal to make some observations upon a larger and more general theme. The thesis which I propose to uphold may not fall very obviously within the scope of the original aims of the British Association, but it has, at least, an intimate bearing on the work of those who are concerned with the applications of mechanical science.

Tredgold's oft-quoted definition of engineering as "the art of directing the great sources of power in nature for the use and convenience of man" may well be taken, and often has been taken, as a text upon which to hang a discourse on the importance of the profession to which many of us belong, the leading part it has played in the process of civilisation, and the dependence of the world to-day on its activities. But the words suggest failures as well as achievements, and responsibilities no less than privileges. The definition suggests that the engineer not only fails in his vocation if he does not accomplish something for the use and convenience of man, but further, that he acts contrary to the spirit of his profession if he directs the sources of power in nature to the unuse or inconvenience of man; and surely we must understand by "man" not the engineer's immediate client but mankind in general. The works of the engineer are to be used by some people; they have to be endured by all.

Taking the highest view of our calling—and surely we do not hold that ours is in any sense a sordid or selfish vocation—the engineer fails in the fulfilment of his duty in so far as his works are detrimental to the health or destructive to the property of the community, or in so far as they are unnecessarily offensive to any of the senses of those who are compelled to live with them. There has been too great a neglect of such considerations. The medical practitioner is held to be negligent of his duty if he acts solely in the immediate interests of his patient, and does not take due precaution to guard against the spread of disease or the offence of the community by the exhibition of unsightly forms. We should take as high a view of our responsibilities.

In his presidential address to the Association last year, Sir Wm. Ramsay said that the question for the engineer has come to be not "can it be done?" but "will it pay to do it?" The answer to this question, in respect to any particular proposal, depends on the width of view we take in answering two preliminary questions: whose interests are we to consider? and, what do we mean by paying? Of course, there are limits that must be set in answering each of these; my present contention is that these limits are usually much too narrowly drawn. A road surveyor may save a few pence or shillings to his county council by leaving a piece of newly metalled road unrolled—because the clock strikes the hour for retiring—and may thereby cause expense, amounting to pounds, it may be to hundreds of pounds, through damage to motor-cars or the laming of horses (not to speak of loss of life or limb), to the users of the road, who are, after all, the clientèle he is there to serve. Does it pay? The authorities of a city will spend large sums on the adornment of the streets with stately and ornate buildings, and on the purchase of works of art—and rightly so, though comparatively few of the citizens can appreciate or even give themselves the chance of appreciating them—while they will tolerate or even be directly responsible for the running on these same streets of quite unnecessarily ugly and noisy tramcars, and congratulate themselves on the drawing of a paltry income from the display of hideous advertisements that are constantly before the eyes of the whole community. Does it pay thus to separate æsthetic from utilitarian demands and interests?

It is too much to assume that engineers could meet all the reasonable demands of their immediate clients without producing, at least temporarily, secondary effects that may be of inconvenience to some members of the community. Bacon, indeed, said that "The introduction of new Inventions seemeth to be the very chief of all human actions. Inventions make all men happy without either Injury or Damage to any one single Person." But Bacon was a philosopher, and dealt with ideals rather than with hard facts, and in his times inventors had not yet begun to dominate all the elements of our physical environment. Had he lived to-day beside one of our country roads he might have had something to say, in another key, regarding motor-cars and dust; or had his lot been cast in the proximity of a great centre of industry he might have modified his conviction of the universality of the benefits conferred by the inventor. He might even have been disposed to agree with a literary man of to-day who is reported as asserting that "The universal and blatant intrusion of Science into our lives has resulted in a total disappearance of repose." Isolated and unqualified statements such as those I have quoted are like proverbs—you can always find two that are directly opposed. The truth lies about midway between these extremes, or rather there are aspects of the facts in regard to which one is an approach to the truth, and aspects in which the other has some justification. Our aim should be to make Bacon's dictum have more of truth and Mr. Stephen Coleridge's assertion have less foundation in fact. And the outlook seems to me to be a very hopeful one, though to be able to take an altogether favourable view of the tendencies of the present time, one must be an optimist of the true order—"One who can scent the harvest while the snow is on the ground."

When we examine into the immediate causes of the injuries and inconveniences that result from our activities we find that they are due in all, or almost all, cases to failures rather than to successes. The more completely the engineer achieves the primary end of his work the less is the damage or injury that can be laid to his charge. If it can be shown that this is a very general law, as I think it can be, we may look forward to the elimination, as a direct result of progress in the mechanical arts, of the nuisances and inconveniences for which, in some measure at least, we must accept responsibility. And not only so, but the converse will be equally true—the more we keep in view the removal or avoidance of anything that can cause offence, the more rapidly we shall advance in the attainment of the primary ends at which we aim. Consider, by way of example, the nuisance to which I have referred, and of which we hear so much—the raising of dust by motor-cars. I shall not discuss the debated question as to how far the motor-car produces dust, or only distributes it, nor shall I deal in detail with the possible remedies. We hope to have a paper on the subject at this meeting from one of our leading authorities. For my present purpose it suffices to point out that it is no part of the function of a road surface to fritter itself down into dust under traffic of any kind. The ideal road would be one that would not wear at all, and the nearer we approach this ideal of a permanent road surface, the less will be the inconvenience caused, not only to those responsible for the upkeep of the road, but to the general public. And conversely, the more attention we give to the devising of a dustless road the more rapid will be our advance towards the provision of one best suited for all the purposes which a road is intended to serve. We had dusty roads

---

[1] We have no word to denote very clearly the negative of *use*, as the term here applied: *unuse* may serve for the present.

before the motor-car came into being, but the demand that is being forced upon the engineer to eliminate this nuisance is leading to an improvement of our roads for all users. The inventors of the automobile will yet merit the thanks even of those who, bemoaning the blatant intrusion of science into our lives, may discard the railway train and the motor-car and take to the stage-coach of their grandfathers with a view to the recovery of some of the lost repose.

Again, the combustion of fuel does little harm to anyone; it is the imperfection of the combustion that is the main cause, almost the sole cause, of injury to health, to property, and to the amenity of populous centres. Of course, one knows that smokeless combustion is not necessarily, nor always, the most economical, but that is only because we have not yet learned how to use fuel in anything like a perfect manner. But all the tendencies at the present time are towards improvement, and the more attention we pay to the elimination of the smoke nuisance the more rapid will be our progress in the economical use of one of the most valuable of our inheritances. It is therefore clearly the duty of every engineer who has to do with power or heat production—for the credit of his profession and even in the interests of his immediate clients—to consider the use and convenience of all who can be affected by the work for which he is responsible. The time is not far distant when the direct burning of bituminous coal in open grates will be looked upon as not only a source of serious harm but as a culpably wasteful practice. Great progress has been made in processes for the partial distillation of coal by which a free-burning and quite smokeless fuel is prepared and valuable by-products (so-called) are conserved. If all engineers concerned with the design and application of plants in which coal is used had a due sense of their responsibilities to the community, progress would have been, and would to-day be, much more rapid; and economies would be effected that would, in themselves, amply justify the application of more scientific methods of utilising the constituents of a very complex material, which we are too apt to look upon as merely a convenient source of heat—plentiful enough and cheap enough, as yet, to be used in a most wasteful manner. It will not be to the credit of our profession if it should require restrictive legislation not only to prevent a gross interference with the health and comfort of the community and the amenities of our centres of industry or of population, but to effect economies in the utilisation of the chief of the sources of power which it is our function to direct to the best advantage of all concerned.

In other directions also we see that progress towards economy is leading to a reduction, and possibly to the entire elimination, of all the nuisances associated with the older methods of power and heat production. The great improvements that have recently been made in producer plants and gas engines have rendered out of date, as regards economy, at least the smaller sizes of steam plants which are so fruitful a source of injury and inconvenience to the community; and we now have engines of the Diesel, and the so-called semi-Diesel, types that can utilise natural oils, and oils obtained in the distillation or partial distillation of coal, not only with an efficiency hitherto unattained in heat-engines, but "without injury or damage to any one single person"—except possibly the maker of inferior [2] plants.

Present indications point to the coming of a time, in the near future, when the power and heat required for industrial and domestic purposes will be distributed electrically, in a perfectly inoffensive manner, from large central stations; and even at these stations there will be no pollution of the atmosphere that could give the most sensitive of critics any just grounds of complaint against the intrusion of science into our lives. In his presidential address to the Institution of Electrical Engineers in November, 1910, Mr. Ferranti dealt in a most masterly way with this, which is undoubtedly the greatest of the many schemes at present before the engineering profession. That address reads like a chapter from a romance of Utopia, but unlike most of the forecasts that have been presented to us of ideal conditions in a world of the future, the system which Mr. Ferranti sketches out, and advocates with so much knowledge and convincing argument, does not depend for its reasonableness on the postulation of a perfected humanity. It would not only provide vastly improved conditions of life for the community as a whole, but it would satisfy the more selfish aims of the users of power and the makers of machinery, by increasing the economy of production and stimulating the demand for mechanical appliances. No doubt there may be some who will hold that to commend any worthy scheme, to those who might carry it out, by an appeal to their selfish interests is an altogether immoral kind of argument. I do not think so. Advancement of the race through benefits to the individual is, at least, not inconsistent with nature's method of securing progress. However much we may desire to develop a purely altruistic spirit in men of all classes, we must meantime make the best of human nature as it is, and recognise that the rapidity of our progress toward better conditions of life will be in proportion to the advantages that each advance can promise to those who would be immediately concerned in its realisation.

It is just a hundred years since passengers were first carried on the Clyde in a mechanically-propelled ship, and to-day—when they are not too completely obscured by smoke—we can see the successors of the *Comet* plying on that river with power plants of greatly superior overall efficiency but showing little advance in regard to the combustion of the fuel. Had the emission of smoke from river craft been prohibited years ago, there is little doubt that engineers would have let few days pass without arriving at some solution of the problem of inoffensive power production, and the demand for economy would have looked after itself. How much better it would be were engineers to take the wider view of their duties and responsibilities to which I have referred, and realise that they are acting contrary to the true spirit of their profession when they produce appliances that pollute the atmosphere for miles around to the hurt and inconvenience of those whose "use" they are intended to serve. But this year a ship has left the Clyde that we hope may be the forerunner of a new race which will attain a higher efficiency than any of the direct descendants of the *Comet*, and that will ply their trade without inconvenience to man or beast, who can claim some right to be permitted to enjoy an unpolluted atmosphere and the measure of sunshine which nature—sparingly enough in those regions—intended to provide.

But there are injuries which we may inflict upon the community other than those to health and physical comfort. Everyone, even the least cultured, has some sense of the beautiful and the comely, and is affected by the aspects of his environment more than he himself can realise. The engineer, then, whose works needlessly offend even the most fastidious taste is acting contrary to the spirit of his profession, at its best.

---

[2] My typist in transcribing a rather illegible draft of this passage substituted for the adjective I have here used the less restrained, but perhaps equally appropriate one, "infernal," but I noticed this in time to amend the emendation. I had no intention to speak so candidly of any of the works of members of my own profession.

There has been far too great a disregard of æsthetic considerations in the everyday work of the engineer—we usually take a too exclusively utilitarian view of our calling. We should not be prepared to accept, as referring to the arts we practise at their best, the distinction drawn by a philosophical writer between "the *mechanical* arts which can be efficiently exercised by mere trained habit, rote, or calculation," and "the fine arts which have to be exercised by a higher order of powers."[3] And I think it can be shown that a greater regard for artistic merit in our designs would not necessarily lead to extravagance, but, in many cases, would conduce to economy and efficiency. It is at least true—and much less than the whole truth—that greater artistic merit than is commonly found in our works could be attained with no sacrifice of structural fitness, or of suitability for the purposes they are designed to serve.

There was a time when engineers made desperate attempts to secure artistic effects by the embellishment (?) of their productions with features which they believed to be ornamental. Fortunately the standard of taste has risen above and beyond this practice in the case of most members of our profession and most of our clients. We are all familiar with illustrations of philosophical instruments, and other mechanical contrivances, of the early times, that vied in lavishness of adornment—though not in artistic merit—with those wonderful astronomical appliances that were carried—as trophies of war!—from Pekin to Sans Souci. Many of us can remember a time when the practice had not altogether disappeared, even in the design of steam engines, lathes, and other products of the mechanical engineer's workshop. I well remember in my apprenticeship days the building of a beam engine that was a triumph of ingenuity in the misapplication of decorative features. In place of the mildly ornamented pillars and entablature of Watt's design, there was provided, for the support of the journals of the beam, a pair of A frames constructed in the form of elaborately moulded Gothic arches flanked by lesser arches on each side, while the beam itself, and many other parts, were plentifully provided with even less appropriate embellishments borrowed from the art of the stonemason. It is some consolation to remember that the clients for whom the engine was built were not of this country, and that the design itself was not a product of the workshop that was favoured with the contract to produce this amazing piece of cast-iron architecture. We have all seen wrought-iron bridges the inattractive features of which were concealed by cast-iron masks—in the form of panelling, or of sham pillars and arches with no visible means of support—that not only have no connection with the structural scheme, but suggest types of construction that could not, by any possibility, meet the requirements. Structures of this kind remind one of the pudding which the White Knight (with good reason when we remember the characteristics of his genius) considered the cleverest of his many inventions. It began, he explained, with blotting-paper, and when Alice ventured to express the opinion that that would not be very nice, he assured her that though it might not be very nice *alone* she had no idea what a difference it made mixing it with other things—such as gunpowder and sealing-wax.

There are, and must always be, wide differences of opinion regarding what is good or bad in matters of taste, but we may go so far in generalisation as to say that we can admire the association of elements we *know* to be incongruous only in compositions that are intended to be humorous. "All human excellence has its basis in reason and propriety; and the mind, to be interested to any efficient purpose, must neither be distracted nor confused."[4] But to be able to judge of the propriety or reasonableness of any composition we must have some knowledge of the essential qualities and relationships of its component parts, and excellence cannot depend upon an appeal to ignorance. We can quite imagine that the White Knight's pudding would appeal as an admirable and most ingenious concoction to one who lacked a knowledge of the dietetic value of blotting-paper and was willing to take for granted the excellence of gunpowder as a spice and of sealing-wax as a flavouring. No artist would be bold enough to include a polar bear or a walrus in the composition of a picture of the African desert, nor be prepared to consider as a legitimate exercise of the artistic imagination the depicting an Arab and his camel wending their weary way across the Arctic snows. He would recognise the incongruity, and might even realise that it is only a lack of imagination or of true inventive power that could lead anyone to resort to such measures for the securing of a desired colour scheme. These are lengths to which even artists will not go in the arrangement of elements in a composition. But an artist *will* secure a colour scheme at which he aims by the introduction into his landscape of a rainbow in an impossible position, or of impossible form or dimensions, or with colours arranged according to his own fancy, though in this there is a much more essential unreasonableness. A polar bear might be transported to the desert, and an Arab might conceivably find his way to the regions of snow and ice, but a rainbow cannot wander from the place assigned to it by nature, nor can it have other than the ordained form or dimensions or sequence of colours. No artist would paint a figure holding a candle and make the light fall on the side of the face remote from the source, but he will, and usually does, paint the moon illuminated on the side remote from the sun. Why? Simply because he has not before his mind the essential absurdity of the scheme, if indeed he knows why the moon shines. Artists who deal with nature in any of its aspects may be commended to "mark, learn, and inwardly digest" Whistler's definition of their calling: "Nature contains the elements in colour and form of all pictures . . . but the artist is born to pick and choose, and group with science, these elements, that the result may be beautiful." Whether or not we are to understand that Whistler intended to include an accurate knowledge of physical facts and phenomena in what he calls *science,* he cannot have meant anything less than *sense.*

So in regard to the arts of construction, we may say that mechanical science provides the elements of all structures, and the craftsman—be he called engineer or architect—is born to pick and choose, and group with science, these elements, that the result may be useful—and not devoid of grace.

The only valid excuse for such departures from the fit and rational in painting or in structural design as those which I have instanced is ignorance on the part of the designer of the nature of the elements he employs, or a lack of skill to devise a possible or reasonable arrangement of details that will secure the general effect he desires.

It may almost savour of sacrilege to quote, in this connection, from the writings of that "Wild, wilful, fancy's child" the story of whose eight short years of life and literary work Dr. John Brown has given in his charming "Pet Marjorie"—a record of perhaps the shortest human life that has formed the subject of a biography. But the lines are too pertinent to my purpose to be withheld, and the frankness of the confessions they contain, of a childlike limitation of artistic power, may be commended to those who practise either the fine arts or the arts of construction, and feel compelled to "trust to their imagination for their facts," or to resort to the association of incompatible details for lack of knowledge, or of ability to attain their ends by more reasonable means.

---

[3] Enc. Brit., eleventh edition, article "Art."

[4] Mr. Duppa's "Life of Michelangelo."

Marjorie writes of the death of James II.:—

> "He was killed by a common splinter,
> Quite in the middle of the Winter;
> Perhaps it was not at that time,
> But I could find no other rhyme?"

"Quite in the middle of the winter" describes August 3, 1460 A.D., with no wider licence than we find assumed in the works of more experienced, if less candid, artists and craftsmen. Again in her sonnet to a monkey—written, we must remember, when she was six or seven years of age—she acknowledges the compelling power of an artistic aim:—

> "His nose's cast is of the Roman:
> He is a very pretty woman.
> I could not get a rhyme for Roman
> So was obliged to call him woman.

It may seem that I have wandered widely from my text: those who found discourses on texts usually do! But there is, or ought to be, a closer connection than is usually recognised between the work of the engineer and that of those to whom we usually restrict the title of artist. There was no great gulf fixed between the fine arts and the utilitarian arts in earlier times. Some at least of those to whom we owe the greatest advances in the fine arts were eminent also in the arts of construction. We may claim such men as Michelangelo, Raphael, and Leonardo da Vinci as masters in the arts of construction as well as in those with which their names are usually associated. The separation of the beautiful and the useful is quite a modern vice. But much that I have ventured to say in the digression—if such it be—is applicable, with little or no alteration of terms, to the work of our own profession. The architect or engineer who, for the sake of effect, fills the space between the flanges of a beam or girder with slabs of stone, or cast-iron pillars and arches, that could not fulfil the function of a web, exhibits just the same lack of skill as Pet Marjorie owns up to—shall I say?—like a *man*. Such practices have no "basis in reason and propriety," and the employment of such "decorative features" is certainly not a "grouping of elements with science." It is said that "The highest art is to conceal art"; the lowest in matters pertaining to our profession is to conceal ill-devised construction with false and senseless masks. But what I have said has, I think, a sufficiently obvious bearing on the mechanical arts—I need not further point the moral.

There is an old maxim to the effect that "the designer should ornament his construction and not construct his ornament." This is an admirable rule so far as it goes, but it should be subordinated to a higher rule, that he should ornament his structure only if he lacks the skill to make it beautiful in itself. A structure of any kind that is intended to serve a useful end should have the beauty of appropriateness for the purpose it is to serve. It should tell the truth, and nothing but the truth, and if its character be such that it can be permitted to tell the whole truth, so much the better. It should be beautiful in the sense in which we commonly use the term with respect to a machine—we call a mechanical device beautiful only if it strikes us as accomplishing the end for which it is designed in the simplest and most direct way. Our works—like the highest creations in nature—should be beautiful and not beautified. "Beautified" should be considered a vile phrase when applied to a work of construction, no less than when used to characterise a fair Ophelia. Artists accept the human form, at its best, as the highest embodiment of grace and beauty, but there is not a curve in the figure that is not the contour of some structural detail that is there for a definite purpose. The practice of resorting to extraneous adornments to minimise crudities of structural scheme had its rise—if I mistake not—in the comparatively recent times when culture and taste were at their lowest. It is specially characteristic not only of earlier times, but of the earlier stages of the design of any particular product. It has already disappeared in some cases, and will continue to disappear from the practice of the arts of construction as skill and taste develop. I have already alluded to the abandonment of ornament in the design of machines, and I think there can be no one, with any sense of the fit and pleasing, who does not approve this change in practice. The stage coach and horses of former times were lavishly decorated—the carriage of to-day is more graceful and pleasing in virtue of the simple elegance of its lines. In the best domestic architecture of to-day we see the same tendency to trust for effect, more and more, to an artistic grouping of the lines and masses of essential parts and the gradual abandonment of purely decorative features, without and within. There was a time when the hulls and riggings and sails of ships were lavishly ornamented; now even the figurehead—the last remnant of barbaric taste—has disappeared; and do we not find in a full-rigged ship of to-day (or yesterday, perhaps one should say) a grace and dignity that no extraneous embellishments would enhance? From the racing yacht the designer has been forced, by the demand for efficiency, to cast off every weight and the adornments that so beset the craft of earlier times, with the result that there is left only a beautifully modelled hull, plain masts, and broad sweeps of canvas, and we can scarcely imagine any more beautiful or graceful product of the constructive arts. These examples will serve to illustrate the contention that the attainment of the highest efficiency brings with it the greatest artistic merit. But in the development of the yacht of to-day, through many stages, the designer has been forced, from time to time, to strive to combine grace with efficiency. Selection on the part of clients must have eliminated ungraceful forms when more beautiful ones could be found, and therefore the advance has been rapid. I think I may appeal to this illustration to support the further contention that advance in efficiency may be helped and not hindered by keeping in view an æsthetic as well as a utilitarian aim. Further illustrations will occur to anyone who has studied the development of design of structures or machines.

It is a matter of constant remark, and with justice, that steel bridges, as a class, are much less pleasing to the eye than those of stone. The reasons for the contrast in artistic merit are not far to seek. The building of stone bridges is an ancient art, and survival of the fittest, and selection—even with little creative skill on the part of the designers—would have led to the development of types having, of necessity, at least the elegance of fitness. But further, this art has come down through the times to which I have referred when artistic and utilitarian aims had not yet been divorced, in the practice of the crafts; and further still, the practice of building in stone has been in the hands of architects as well as of engineers, and architects are expected to be artists, and are trained as such. On the other hand, construction in steel is a very modern art, and it has been in the hands of engineers who usually neglect, if they do not despise, the study of the fine arts. But why have architects, with their artistic training, not succeeded in producing structures in steel as admirably as those they design in stone? Partly, no doubt, because they are hampered by tradition. They have not yet fully realised the difference in spirit that must characterise fit designs in the newer and the older materials. No one can be an artist in any material the possibilities and limitations of which he has not fully mastered. Again—if a common engineer may venture the criticism—the architect, as a rule, has not sufficiently mastered the *science* of construction, and has been too much addicted to taking the easy course of adopting a decorated treatment instead of striving to secure elegance of structural scheme as such; and decoration, at least on anything like traditional lines, is wholly incompatible with the best possibilities of steel as a structural material. Progress is being made in the art of designing efficient and graceful structures in metal, but the best results can only be attained by a designer who has a thorough scientific and technical knowledge of the properties of steel and the processes of its manipulation on the one hand, and cultured artistic sense and capacity on the other. These should not be considered as appropriate equipments for separate professions.

There are many, however, who have a rooted conviction that structures in steel can never be so beautiful as those in stone. This I believe to be altogether wrong. It arises partly from the crudity of design that characterises most of the steel structures that have yet been erected, and partly from preconceived notions as to what is fitting in proportions and massiveness. We can quite imagine that a native of the Congo region whose notions of the proportions suitable and comely for a quadruped were founded on his familiarity with the hippopotamus would, at first sight, consider the racehorse sadly lacking in substance and solidity; but, in time, he might come to recognise some measure of gracefulness in a creature that has been developed to meet requirements that hitherto he had not fully considered.

Mr. Wells has said in his "Modern Utopia," "the world still does not dream of the things that will be done with thought and steel when the engineer is sufficiently educated to be an artist, and the artistic intelligence has been quickened to the accomplishment of an engineer." But we need not postpone until the advent of a complete Utopia, the full realisation of our duty to practise our profession, as far as in us lies, with due regard for the material interests and the æsthetic susceptibilities of all who can be affected by the works for which we are responsible.

NOTES.

A PUBLIC meeting will be held at the Mansion House on Wednesday, October 23, in support of the memorial to Lord Lister.

THE superintendent of the Meteorological Office Observatory at Eskdalemuir, near Langholm, Dumfries, reports that the seismographs at the observatory recorded a large earthquake at 11.30 p.m. on September 13. The centre of the disturbance is indicated at latitude 40·4° N., longitude 27° E., a point situated at the south coast of the Sea of Marmora.

WE learn from *The Lancet* that the Riberi prize of the University of Turin, amounting to 20,000 lire (about 800*l*.), will be awarded after the close of the year 1916 for the work which is adjudged to have most advanced the science of medicine. Such work, if published, must have been printed after 1911. Or it may be sent in before the end of 1916, in print or typoscript—the English language is admissible. Further information may be obtained from Prof. Dr. Oliva, Turin.

A SPECIAL number of the *Atti della R. Accademia dei Lincei*, containing the report of the proceedings at the anniversary meeting last June, announces a gift of 4000*l*. from Dr. Gino Modigliani towards the publication of the works of Leonardo da Vinci, and a legacy to the academy of 2000*l*., as well as of many of her personal effects, from the estate of the late Signora Celli Dutuit. Prizes given by the King of Italy have been awarded to Prof. Ernesto Manasse for mineralogy and geology, and to Prof. Giuseppe Chiovenda for jurisprudence and political science. The Minister of Public Instruction also gives four prizes, each of which has this year been divided, the recipients being Profs. G. Ercolini and A. Amerio for physics, Profs. A. Quartaroli and R. Salvadori for chemistry, and Profs. Enrico Carrara, Donadoni Eugenio, Levi Ezio, and Ribezzo Francesco for the two philology prizes. A prize founded by Santoro is awarded to Prof. Costantino Gorini for his discoveries in the bacteriology of cheese, while another most useful prize, founded by the late Alfonso Sella for assistant lecturers in the department of physics, is awarded to Dr. Paolo Rossi, of the University of Naples.

WE announced with regret last week the death on September 4, at forty-two years of age, of Dr. Stanley Dunkerley, formerly professor of engineering in the University of Manchester. Dr. Dunkerley was educated at the Burnley Grammar School and Manchester University, where he graduated in 1900 with honours in mathematics, and took, a year later, the degree in engineering. After two years on the construction work of the Manchester Ship Canal, he obtained the Bishop Berkeley fellowship, and returned to the University to carry out researches in the Whitworth Engineering Laboratory under the direction of the late Prof. Osborne Reynolds. Dr. Dunkerley held appointments as assistant-lecturer in engineering at Liverpool University and at Cambridge. In 1897 he was appointed professor of applied mechanics at the Royal Naval College, resigning in 1905 to succeed Prof. Osborne Reynolds at the Manchester University. He had only held this post three years when ill health compelled him to resign. Dr. Dunkerley was strongest on the mathematical side of engineering. His most important contributions to engineering science are the paper on the whirling and vibration of shafts published in the Transactions of the Royal Society, and an investigation of the straining actions in crank shafts, which appeared in the transactions of the Institute of Naval Architects. He was the author of text-books on mechanism and hydraulics. In 1905 his University conferred on him the doctor's degree in science, and in the same year he was elected a member of the Institution of Civil Engineers.

THROUGHOUT the wide circle of mining engineers the announcement of the death of Mr. J. A. Chalmers at Bournemouth, on September 9, will be deeply